

443
Ar/19
R.

UNIVERSITY OF WYOMING

PROPERTY OF
BUREAU OF LAND MANAGEMENT
D S C LIBRARY

COOPERATIVE RESEARCH REPORT TO THE BUREAU OF LAND MANAGEMENT

1962 Results



HALOGETON RESEARCH

Arid Land Studies of Grazing Treatments, Ecology,
Shrub Improvement and Control, and Moisture Relationships

SUBMITTED BY WYOMING AGRICULTURE EXPERIMENT STATION

APRIL, 1963

TABLE OF CONTENTS

	<u>Page</u>
Introduction.	1
Winter Sheep Grazing Study on Saltsage Range (Greybull) by H. G. Fisser and J. T. Nichols	2-6
Summer Steer Grazing Study on Saltsage Range (Worland). by H. G. Fisser and J. T. Nichols	7-11
Exclosure Studies (Production, Cover, Height, and Moisture Phase) by H. G. Fisser and R. W. Hamner	12-38
Selection and Improvement of <u>Eurotia lanata</u> (Winter-Fat). by W. A. Riedl Loren Nelson W. W. Ellis Morton May	39
<u>Eurotia lanata</u> Seeding Trials by Morton May	40
Effect of Big Sagebrush Control upon the Cover and Production of Native Forage Species, Soil Moisture Content, and Snow Cover and Moisture Content. by E. W. Chamberlain	41-43

INTRODUCTION

Halogeton (Halogeton glomeratus), an annual poisonous weed which was introduced into the United States in the recent past, has become economically important to range-men. It has invaded vast areas of arid grazing lands and has caused considerable loss due both to its poisoning properties and to its ability to compete with native forage plants. Since so called "shotgun" methods have not controlled this invader, studies have been developed to evaluate its ecological niche with respect to grazing and to native species.

Personnel of the University of Wyoming Plant Science Division began a concentrated study through the cooperation of the Bureau of Land Management in 1955 to evaluate the response of halogeton to various grazing treatments and range management improvement practices. Additional studies were inaugurated to determine which rangeland areas within Wyoming are subject to its encroachment.

Present studies include: (1) the winter sheep grazing trials in pastures near Greybull, (2) the summer steer grazing tests west of Worland, (3) ecological studies of native and invader species with the aid of exclosures located in Wyoming's arid lands from the Montana border to Colorado, (4) selection and improvement of winterfat, (5) seeding trials with winterfat, and (6) sagebrush control and moisture relationship studies.

WINTER SHEEP GRAZING STUDY ON SALTSAGE RANGE

by
H. G. Fisser and J. T. Nichols 1/

Introduction

In cooperation with the Bureau of Land Management, experimental pastures were established in 1956, approximately 15 miles north of Greybull, Wyoming (T53N, R95W, Sec. 3) upon what was considered to be typical winter sheep range of the Big Horn Basin. The vegetation of this area is dominated principally by saltsage (Atriplex nuttallii).

The objectives of this study were to determine the effect of different intensities of winter sheep grazing upon: (1) the spread or containment of halogeton, (2) production of saltsage, and (3) animal responses in terms of weight. In 1961, the study of animal responses were discontinued since greater numbers of ewes were grazed for a shorter period of time in each pasture to facilitate better grazing distribution. The shorter grazing period invalidated any weight comparison.

During the 1962 grazing period, Mr. Harry Grabbert of Emblem, Wyoming furnished 638 head of ewes and 12 bucks from October 28 to November 14.

Methods and Procedures

The total study area of 640 acres was divided into seven individually fenced units one of which was used as a holding pasture. The other six pastures were arranged in a modified randomized block design in which two replications of three intensities of grazing were located. The three rates of use were light, moderate, and heavy on which the desired percentages of utilization were set at 20, 40, and 80 percent, respectively. Pasture sizes were 160, 80, and 40 acres. Like numbers of sheep were placed on each pasture subject to inherent productive potential on differing units.

Production of saltsage was estimated by clipping 10 plots, each 100 sq. ft. in area, within each pasture. Utilization was determined by clipping an additional 10 plots in each pasture after all animals were removed. Vegetation analyses were conducted by the point-frame method. Ten permanent line transects 50 feet long were established in each pasture. Each transect was evaluated on the basis of 300 point recordings by systematic placement of a point frame with 10 pins. A complete description of procedures and permanent plot locations is on file with the Plant Science Division of the University of Wyoming.

1962 Results

All pastures were grazed for 18 days from October 28 to November 14, 1962. Numbers of sheep per pasture were determined on the basis of production estimates prior to grazing. These are given on the following page.

1/ Assistant Professor and Graduate Assistant, respectively, Plant Science Division, University of Wyoming, Laramie, Wyoming.

No. of SheepPasture No. and Rate of Use

100	1	Moderate
90	2	Heavy
125	4	Light
110	5	Moderate
90	6	Heavy
135	7	Light

Optimum forage consumption was set at 4.0 pounds per day per animal. Some differences in numbers of sheep per individual pasture were also necessary due to variations of soil, topography and vegetation. The differences in numbers were imposed in view of attaining the desired rates of utilization on each pasture during a uniform grazing period on all.

Production of saltsage increased considerably on all pastures in 1962 as compared to previous years (Table I). This resulted primarily from the favorable moisture conditions during much of the growing season. In 1962, 3.01 inches of precipitation were recorded for the period April 15 through June 30, as compared to 1.35 inches for 1961, and .60 inches for 1960. During 1962 average increase in production of 57.0 percent was noted on all pastures as compared to 1961. Production of saltsage on the heavy use pastures was 16 percent less than the moderate, and 32 percent less than the light. Increased production was also reflected in the greater sheep days per acre which were doubled on all pastures during 1962 as compared to 1961 (Table II).

Average production of saltsage on the heavy use pastures was 199.8 lbs. per acre. Production in the moderate and light use areas was 237.4 lbs. and 291.5 lbs. respectively. Previous years data did not indicate significant statistical variation between treatments. The 1962 data, on the basis of Duncan's Multiple Range Test, however, indicated a significant difference between the heavy rate of use and the moderate and light. Visual observation of the heavy use pastures showed a breaking down of saltsage clumps and an increase of halogeton. Variation between the light and moderate use pastures was significant but several years data will be required prior to determination of optimum use rates of saltsage by winter sheep grazing.

Utilization rates, as given in Table II, varied somewhat from the desired values of 20, 40 and 80 percent. Although not of great importance with respect to the study objectives at this time, efforts will be made to more closely approximate the above figures.

Vegetation cover data as derived from point quadrats, are given in Table III. Average cover of saltsage was relatively uniform over all pastures although 2.66 percent less cover was noted in the heavy use pastures as compared to the moderate. Halogeton and other annual weeds were considerably greater on the heavy use pastures than on the others. Some exceptions in annual weed cover were noted, Western Stickseed (Lappula redowskii) and Nuttall Monolepis (Monolepis nuttallii), and cannot be fully explained. Total average cover on the heavy use pastures was 24.62 percent as compared to 20.28 and 18.66 on the light and heavy. These variations resulted primarily from the abundant annual weed growth. Favorable moisture probably accounted for much of the weedy growth. Perennial grasses were very sparse. Very interestingly, the two species noted, Squirreltail Bottlebrush (Sitanion hystrix) and Sandberg bluegrass (Poa secunda), were not encountered on the light use pastures.

Composition percentages based on vegetation cover, indicated more striking response to grazing treatment (Table IV). Saltsage composition percentages were much lower and halogeton much higher, on the heavy use pastures as compared to the light and moderate. The influence of weather upon annual weed populations is not fully understood and will be studied with respect to grazing treatment.

TABLE I. PRODUCTION OF SALTSAGE UNDER DIFFERENT INTENSITIES OF GRAZING (POUNDS AIR-DRY FORAGE PER ACRE).

Pasture No.	Light Use		Moderate Use		Heavy Use		Mean
	4	7	1	5	2	6	
1958	166.8	165.9	136.8	186.7	117.1	184.8	
Mean	166.4		161.8		150.9		159.7
1959	225.9	221.1	212.9	255.9	107.5	235.8	
Mean	223.5		229.4		203.2		209.9
1960	129.2	95.6	106.3	108.9	21.7	67.9	
Mean	112.4		107.6		69.8		96.6
1961	152.9 ^a	119.1 ^{abc}	102.1 ^{bc}	121.6 ^{ab}	42.9	85.1 ^c	
Mean	136.0		111.7		64.0		103.9
1962	282.2 ^d	300.8 ^d	232.3 ^{bc}	242.5 ^c	201.6 ^{ab}	197.8 ^a	
Mean	291.5 ^c		237.4 ^b		199.8 ^a		242.9

Sets of pasture means containing the same exponent are not significantly different at the 0.05 confidence level.

TABLE II. SHEEP DAYS PER ACRE AND PERCENTAGE UTILIZATION UNDER DIFFERENT INTENSITIES OF GRAZING

	<u>Sheep days per acre</u>	<u>Percentage Utilization of Saltbush</u>
Light Use		
1958	9.51	6.50
1959	14.77	31.30
1960	7.79	11.60
1961	6.95	17.79
1962	14.63	28.60
	Mean 10.73	Mean 19.16
Moderate Use		
1958	18.48	36.00
1959	30.47	54.00
1960	13.79	39.47
1961	12.31	30.39
1962	23.63	48.30
	Mean 19.74	Mean 41.63
Heavy Use		
1958	34.50	54.60
1959	55.31	86.60
1960	16.82	74.10
1961	15.08	80.98
1962	37.13	71.35
	Mean 31.78	Mean 73.53

TABLE III. PERCENTAGE VEGETATIVE COVER, UNDER DIFFERENT INTENSITIES OF GRAZING 1962.

Species	<u>Light Use</u>		<u>Moderate Use</u>		<u>Heavy Use</u>	
	4	7	1	5	2	6
Atriplex nuttallii	14.17	12.83	14.20	16.33	12.80	11.32
Halogeton glomeratus	.33	.03	.03	.43	3.83	5.30
Descurania pinnata	.83	.30	.07	.23	1.97	.57
Lepidium densiflorum	.63	.57	.10	.90	.47	.93
Polanesia trachyasperma			.03	.03		.03
Opuntia polyacantha	.20	.03	.77	.53	.27	.30
Gilia sp.	.27	.57	1.07	.33	.30	.40
Astragalus sp.			.40			.03
Musineon divaricatum			.03		.01	
Lupinus sp.			.03			
Euphorbia serpens			.03	.13		
Aster canescens			.03			
Oenothera albicaulis			.03			
Sphaeralcea coccinia						
Lappula redowskii	2.13	2.20		.47	3.17	2.33
Stanleya viridiflora	.13	.60		.50	.70	.43

TABLE III. PERCENTAGE VEGETATIVE COVER, UNDER DIFFERENT INTENSITIES OF GRAZING 1962. (Cont.)

Species	Light Use		Moderate Use		Heavy Use	
	4	7	1	5	2	6
<i>Monolepis nuttallii</i>	.43	3.66		.07	3.23	
<i>Allium textile</i>	.13	.17		.13	.10	.10
<i>Salsola kali</i>	.03				.13	
<i>Machaeranthera tanacetifolia</i>		.33	.30			
<i>Artemisia spinescens</i>			.07			.20
<i>Sitanion hystrix</i>				.03	.03	.30
<i>Poa secunda</i>				.03		
Pasture means	19.28	21.29	17.19	20.14	27.01	22.24
Treatment means		20.28		18.66		24.62

TABLE IV. PERCENTAGE COMPOSITION UNDER DIFFERENT INTENSITIES OF GRAZING, 1962.

Species	Light Use		Moderate Use		Heavy Use	
	4	7	1	5	2	6
<i>Atriplex nuttallii</i>	72.83	61.84	83.32	81.22	49.02	55.72
<i>Halogeton glomeratus</i>	1.79	.16	.18	2.71	14.33	19.38
<i>Descurania pinnata</i>	2.49	1.30	.32	1.05	7.75	2.10
<i>Lepidium densiflorum</i>	3.22	2.43	.63	3.96	2.07	3.81
<i>Artemisia spinescens</i>			1.41			1.18
<i>Polanisia trachyasperma</i>			.24	.12		.19
<i>Opuntia polyacantha</i>	1.04	.16	3.79	2.57	1.07	1.95
<i>Gilia</i> sp.	1.45	2.41	6.52	1.38	1.06	1.73
<i>Astragalus</i> sp.			2.45			.19
<i>Musineon divaricatum</i>			.31		.79	
<i>Lupinus</i> sp.			.31			
<i>Euphorbia serpens</i>			.24	.51		
<i>Aster canescens</i>			.14			
<i>Oenothera albicaulis</i>			.18			
<i>Sphaeralcea coccinium</i>						
<i>Lappula redowskii</i>	10.17	9.45		2.56	10.89	10.15
<i>Stanleya viridiflora</i>	.60	4.46		2.56	2.62	1.42
<i>Monolepis nuttallii</i>	3.82	14.59		.37	10.36	
<i>Allium textile</i>	.74	.63		.96	.53	.45
<i>Salsola kali</i>	.09				.67	
<i>Machaeranthera tanacetifolia</i>		.15				
<i>Sitanion hystrix</i>				.14	.14	1.45
<i>Poa secunda</i>				.14		

*Percentage Composition

SUMMER STEER GRAZING STUDIES ON SALTSAGE RANGE (WORLAND)

by
H. G. Fisser and J. T. Nichols 1/

Introduction

The North Fork Experimental Pastures, located on the North Fork of the 15-Mile Drainage, were established in 1960. These pastures are located approximately 12 miles west of Worland, Wyoming, in an area dominated principally by saltbush (Atriplex nuttallii). Annual precipitation was light--an average of 5.23 inches occurred over the last three years.

Two pastures were established for comparison of animal and vegetation responses. The treated pasture, which consisted of 521.3 acres, was treated with waterspreaders and seeded to Crested wheatgrass, (Agropyron cristatum), Tall wheatgrass, (Agropyron elongatum), and fireweed, (Kochia scoparia). The check pasture was non-treated native saltbush (Atriplex nuttallii) range, and consisted of 488.8 acres.

For the past three years, yearling steers have been furnished by the University of Wyoming Agricultural Substation at Powell, Wyoming.

Methods and Procedures

Vegetation analyses were conducted by the point-frame method. Permanent line transects 50 feet long were established in each pasture on which contiguous point frames were placed. In the treated pasture, analyses were conducted on three kinds of sites: (1) seeded areas adjacent to the dikes where a stand of grass was established, (2) unaffected areas of native saltsage range away from the immediate dike area, and (3) inter-dike areas where the vegetation was destroyed during dike construction but where seeded grasses failed to establish.

Production of herbage was estimated by clipping plots, 9.6 sq. ft. in area, which were systematically located along each transect. Plots were caged during the grazing period and clipped at the end of the growing season.

Utilization was estimated on a percentage of weight removed basis. Five samples were taken on each transect by placing a 2 ft. x 2 ft. frame at 10 ft. intervals. The check pasture was estimated in a like manner except that a 1 x 9.6 ft. frame was utilized to insure inclusion of adequate plant cover.

Forty-three yearling steers were grazed for 73 days during the summer of 1962 from July 3 until September 4 -- twelve head on the check pasture and 31 head on the treated pasture. Individual weights were recorded for each animal when placed on the pastures and again upon removal (Table I).

1/ Assistant Professor and Graduate Assistant, respectively, Plant Science Division, University of Wyoming, Laramie, Wyoming.

1962 Results

Animal responses (Table I) to the treated pasture as compared to the check pasture indicated an advantage of 3.89 pounds per acre more gain on the treated areas as well as a 25 percent greater average daily gain per animal. The stocking rate was 2.5 times greater on the treated pasture than on the check area.

The vegetation of the check or native pasture (Table II) was dominated by saltsage which made up 18.70 percent cover and 59.81 percent of the composition. Other species present primarily annuals of which Tansyleaf Aster (Machaeranthera tanacetifolia) was the most abundant.

Vegetation of the undisturbed or unaffected part of the treated pasture was essentially the same as the check pasture (Table III).

Cover and composition of the seeded dikes (Table IV) consisted primarily of Crested wheatgrass and Tall wheatgrass, both of which made up 95 percent of the composition and an average ground cover of 35 percent. Other species were present in minute amounts, but did not contribute appreciably to the overall cover and composition.

Western wheatgrass (Agropyron smithii), a native species, appeared to be establishing in isolated patches along the dikes and may become sufficiently established to be of significance in the future. Seedlings of several woody plants were also becoming evident on some of the more mesic dike areas and drainages. Among these were silver sagebrush (Artemisia cana), tamarix (Tamarix sp.), cottonwood (Populus sp.), and willow (Salix sp.). If this trend continues these woody species may eventually become competitors with the seeded grass species.

Interdike areas in which the native saltsage vegetation was destroyed and seeded grasses failed to establish were occupied by weedy species, and are of interest primarily from a successional standpoint. Nuttall Monolepis (Monolepis nuttallii) and Halogeton (Halogeton glomeratus) were the principal species with only minute amounts of perennial vegetation present (Table V).

Production of herbage (Table VI) on both the treated and check pastures was greatly increased in 1962 as compared to 1960 (no estimate for 1961 due to heavy rains in the fall). Crested wheatgrass yielded over 2½ times more in 1962, and saltsage more than doubled in yield. The higher yields were a result of high precipitation in the fall of 1961, and a wet, favorable growing season during the spring and early summer of 1962.

Herbage utilization on the treated pastures was concentrated primarily on the seeded species with 38.17 percent estimated on crested wheatgrass and 7.50 on tall wheatgrass (Table VII). Tall wheatgrass was not utilized efficiently due to the protection offered to new growth by the standing dead plant material from previous years. Older clumps of crested wheatgrass were also protected in this manner, but not nearly as extensively. Thus, the overall utilization pattern was patchy. Younger plants, and areas of heavier utilization during previous years, received the major part of grazing.

Saltsage within the treated pasture (unaffected area Table VII) was utilized very little. Only occasional plants were grazed near the seeded areas. The indication being that saltsage was utilized only as a variation in diet and did not contribute appreciably to overall carrying capacity of the treated pasture.

Saltsage utilization within the check pasture (Table VII) was estimated at 6.9 percent--this figure represented light use, but considering the overall utilization of all forage species within the pasture, a heavier rate probably would not have been desirable (quantative data only on saltsage). It was noted that saltsage was not grazed until most of the other native species of grasses and forbs along the drainage had been almost completely utilized to increase the stocking rate so as to obtain a more efficient use of saltsage would most likely result in deterioration of these other species.

TABLE I. STOCKING RATE AND ANIMAL RESPONSE, NORTH FORK EXPERIMENTAL AREA, 1960 TO 1962.

	Check			Treated		
	1960	1961	1962	1960	1961	1962
No. of days grazed	43	43	73	43	43	73
No. of animals	18	13	12	35	35	31
A.U.D.'s per acre	1.52	1.32	1.79	2.95	2.89	4.34
Avg. daily gain per animal	0.46	0.70	0.98	0.82	1.60	1.30
Lbs. gain per acre	0.70	0.87	1.75	2.41	4.64	5.64

TABLE II. COVER, COMPOSITION, AND FREQUENCY ON CHECK PASTURE OF NORTH FORK EXPERIMENTAL AREA 1962

Species	Percentage Cover	Percentage Composition	Percentage Frequency
<i>Atriplex nuttallii</i>	18.70	59.81	61.67
<i>Plantago purshii</i>	1.13	3.62	8.33
<i>Machaeranthera tanacetifolia</i>	6.26	20.04	33.67
<i>Musineon divaricatum</i>	1.33	4.37	9.67
<i>Lappula redowskii</i>	0.83	2.67	6.33
<i>Lomation orientale</i>	0.07	0.21	0.33
<i>Halogeton glomeratus</i>	0.33	1.07	2.33
<i>Allium textile</i>	0.30	0.53	1.67
<i>Monolepis nuttallii</i>	0.90	2.77	6.67
<i>Opuntia polyacantha</i>	1.33	4.26	3.67
<i>Lepidium densiflorum</i>	0.03	0.11	0.33
<i>Gilia</i> sp.	0.67	0.21	0.33
<i>Sporobolus cryptandrus</i>	0.03	0.11	0.33

TABLE III. COVER, COMPOSITION, AND FREQUENCY OF UNAFFECTED AREA (NATIVE RANGE) IN SEEDED PASTURE OF NORTH FORK EXPERIMENTAL AREA, 1962.

Species	Percentage Cover	Percentage Composition	Percentage Frequency
<i>Atriplex nuttallii</i>	9.87	62.71	38.00
<i>Plantago purshii</i>	0.60	3.81	6.00
<i>Musineon divaricatum</i>	1.80	11.44	11.33
<i>Monolepis nuttallii</i>	1.20	7.63	10.00

(CONTINUED) TABLE III. COVER, COMPOSITION, AND FREQUENCY OF UNAFFECTED AREA (NATIVE RANGE) IN SEEDED PASTURE OF NORTH FORK EXPERIMENTAL AREA, 1962.

Species	Percentage Cover	Percentage Composition	Percentage Frequency
Halogeton glomeratus	0.87	5.51	6.67
Gilia sp.	0.07	0.42	.67
Machaeranthera tanacetifolia	0.93	5.93	5.33
Sitanion hystrix	0.40	2.54	4.00

TABLE IV. BASAL COVER, COMPOSITION, AND FREQUENCY OF SEEDED DIKES NORTH FORK EXPERIMENTAL AREA, 1962.

Species	Percentage Cover	Percentage Composition	Percentage Frequency
Agropyron cristatum	28.83	77.44	70.88
Agropyron elongatum	6.40	17.19	10.53
Sitanion hystrix	0.40	1.07	1.23
Kochia scoparia	0.10	0.27	0.53
Xanthium commune	0.07	0.18	0.35
Musineon divaricatum	0.10	0.27	0.53
Plantago purshii	0.03	0.09	0.18
Monolepis nuttallii	0.03	0.09	0.18
Eriogonum cryptandrus	0.40	1.07	1.05
Agropyron smithii	0.07	0.18	0.35
Atriplex nuttallii	0.20	0.54	0.88
Poa secunda	0.17	0.45	0.88
Opuntia polyacantha	0.10	0.27	0.53
Schedonardus paniculatus	0.13	0.36	0.53
Artemisia cana	0.20	0.54	0.88

TABLE V. COVER, COMPOSITION, AND FREQUENCY OF AREAS BETWEEN DIKES WHERE SEEDED GRASSES FAILED TO ESTABLISH, NORTH FORK EXPERIMENTAL AREA, 1962.

Species	Percentage Cover	Percentage Composition	Percentage Frequency
Plantago spinescens	1.58	6.09	10.00
Halogeton glomeratus	4.08	15.71	25.16
Lappula redowskii	1.67	6.41	12.50
Sitanion hystrix	1.58	6.09	13.33
Monolepis nuttallii	13.00	50.00	52.50
Oryzopsis hymenoides	0.25	0.96	2.50
Musineon divaricatum	0.83	3.21	7.50
Poa secunda	0.25	0.96	2.50
Hordeum jubatum	0.25	0.96	2.50
Allium textile	0.08	0.32	0.83
Machaeranthera tanacetifolia	1.50	5.77	7.50
Atriplex nuttallii	0.42	1.60	1.67
Lepidium densiflorum	0.25	0.96	2.50
Agropyron cristatum	0.17	0.64	1.67
Euphorbia serpens	0.08	0.32	0.83

TABLE VI. PRODUCTION OF AIR-DRY FORAGE PER ACRE ON THE NORTH FORK EXPERIMENTAL AREA, 1960 and 1962.

Species	Treated Pasture				Check Pasture	
	Seeded Area		Unaffected Area		1960	1962
	1960	1962	1960	1962		
Agropyron cristatum	570.63	1580.55				
Agropyron elongatum	579.34	447.38				
Agropyron spicatum	P*				P	
Bouteloua gracilis					P	
Munroa squarrosa			P		P	
Oryzopsis hymenoides	P		P		P	
Poa secunda			P	P		
Sitanion hystrix	121.97		P	P		P
Sporobolus cryptandrus			P		P	
Halogeton glomeratus	13.07		P		P	P
Kochia scoparia	182.95	12.32				
Misc. unidentified forbs	P	P	P	P	P	P
Artemisia spinescens			P		P	
Atriplex nuttallii	60.98	P	217.8	516.00	274.4	559.62
Musineon divaricatum				10.31		P
Plantago purshii				P		P
Machaeranthera tanacetifolia				12.30		16.70

P = Present, but less than 5# per acre.

TABLE VII. PERCENTAGE UTILIZATION OF MAJOR SPECIES ON THE NORTH FORK EXPERIMENTAL AREA, 1960 AND 1962

Species	Treated Pasture				Check Pasture	
	Seeded Area		Unaffected Area		1960	1962
	1960	1962	1960	1962		
Agropyron cristatum	47.3	38.17	-	-	-	-
Agropyron elongatum	38.3	7.50	-	-	-	-
Sitanion hystrix	39.3	-	-	-	-	-
Kochia scoparia	33.4	-	-	-	-	-
Atriplex nuttallii	77.1	-	29.8	Trace	54.3	6.9

EXCLOSURE STUDIES (PRODUCTION, COVER, HEIGHT, AND MOISTURE PHASE)

by
H. G. Fisser and R. W. Hamner 1/

Introduction

Work was initiated during the 1962 field season on a new phase of vegetation study involving halogeton exclosures. Most of these exclosures were constructed in 1959 and 1960. Previous investigations consisted of vegetation analysis by cover and composition determinations with point frames on permanently located quadrats and evaluation of soil characteristics. Quadrat studies were to be rerun at five year intervals. The next series of data will be obtained during the summer of 1965.

The objectives of the new research program are to determine:

1. The relationship of herbage production to area cover percentages.
 2. The relationship of annual herbage production changes to variations in time and amount of available moisture.
 3. The relationship of plant height of major forage species to annual herbage production and to time and amount of available moisture.
- The influence of several range improvement practices upon herbage production, area cover, and plant height.
5. The relationship of percentage frequency to area cover and herbage production.
 6. Greater knowledge of soil temperatures, soil moisture, and snow pack in relation to forage utilization and shrub control studies.

Methods and Procedures

Area cover, herbage production, and height data studies on sagebrush-grass sites were conducted with 12 x 12 in. quadrats located systematically along a randomly located 100 ft. steel tape. The term "transect" has been applied to evaluations of ten quadrat placements on a line. On sites dominated by saltsage data were obtained in like manner except that plot size was 1 x 10 ft. The plot was placed at right angles to the steel tape and vegetation data were subdivided into ten subplots.

Area cover of herbaceous and low growing semi-woody species was estimated within each square foot plot on the basis of basal cover concept. Quantitative data were somewhat greater than those obtained by the true basal area procedures because some allowance was accorded to foliage projection beyond the actual plant perimeter at ground level. This variance was greatest with low growing and mat forming species but was restricted to an area in which presence of other species was excluded because of dense herbage at ground level.

Assistant Professor and Graduate Assistant, respectively, Plant Science Division,
University of Wyoming, Laramie, Wyoming.

Shrub crown cover, including cactus, was estimated within the square foot plots but these data were not combined when comparing area cover to forage production. Shrub seedling numbers within the plots were recorded as well.

Forage production was determined by clipping at ground level. All perennial species were placed in individual sacks. Annual grasses and annual forbs were placed in separate bags for weighing but species of both groups were recorded individually with respect to area cover. The clippings were oven dried at 70°C for 24 hours prior to weighing. Weights were recorded to one-hundredths of a gram. These small values do not infer absolute accuracy but were a means of recording weights of small plant segments more nearly accurate than if larger weight units were employed.

Height data were recorded only for the more important perennial species. These were measured on a metric basis and will be correlated with weight and precipitation data in future years.

Simple aluminum rain gauges were installed at each exclosure. Precipitation data were recorded four times a year - April 15, July 1, September 1, and October 15. Future studies will include the evaluation of the relationship of precipitation differences both in time and amount to variations in forage production.

Studies have been inaugurated on two exclosures to evaluate snow cover during the winter. Data were used to compare controlled and non-controlled sagebrush sites both on grazed and non-grazed range. Additional research will be conducted to determine soil moisture and soil temperature on a year-round basis.

1962 Results

Production studies were initiated on 20 exclosures during the 1962 field season. Only one transect was recorded within each exclosure which had not been subjected to range improvement practices. Areas within some of the exclosures had been sprayed to control sagebrush, or were seeded and pitted. Transects were established within each of the exclosure areas which received one of the above treatments. Area, cover, height, weight, and precipitation data from the transects are given following the short description and discussion of pertinent data concerning the exclosures. Natural changes within the exclosures are usually very slow necessitating study for several years.

1. Ant Eradication Exc. West of Worland. Const. in 1957. Clipped 20 Aug. 62.

Sagebrush-Grass Type. No treatments. Rain Gauge 56.

The exclosure was originally located to evaluate ant control procedures. Big sagebrush was low in height and the only grasses present were western wheatgrass and Sandberg bluegrass.

2. Boysen Exc. North of Shoshoni. Const. in 1960. Clipped 4 Aug. 62.

Blue Grama Type. No treatment. Rain Gauge 10.

The vegetation is very distinctive type commonly found in the rain-shadow area South of the Owl Creek Range. Soil surface is an erosion pavement. Blue grama clumps were hummocked. No other grasses were recorded.

Bud Kimball Exc. Southwest of Tensleep. Const. in 1961. Clipped 20 Jul. 62.

Sagebrush-Grass Type. Spray Treatment. Rain Gauge 42.

Sagebrush was sprayed in June 1961 and a very good kill was obtained. Western wheatgrass and Sandberg bluegrass were the most important grasses. The latter was most abundant in the spray area. Forage production was greatest in the spray area.

4. Buffalo Creek Exc. South of Tensleep. Const. in 1959. Clipped 3 Aug. 62.

Wheatgrass Type. No treatment. Rain Gauge 7.

Big sagebrush was present but very sparse. The major grass was Bluebunch Wheatgrass in rather small clumps. Many annual weeds were present both on the outside and inside of the exclosure. Sandberg bluegrass and western wheatgrass were abundant. Winter fat and blue grama were present.

5. Burnt Wagon Exc. Northwest of Worland. Const. in 1956. Clipped 11 July 62.

Saltsage Type. No treatment. Rain Gauge 17.

Vegetation is almost a pure stand of saltsage with minute amounts of annual and perennial forbs. Grasses are not present to any extent. Protection from grazing has shown very little change in cover or composition although differences in forb species are beginning to show. A definite trend may develop in later analyses.

6. Cochran Exc. East of Thermopolis. Const. in 1960. Clipped 3 Aug. 62.

Sagebrush-Grass Type. Seeding, Pitting and Spray Treatments. Rain Gauge 76.

Seeding and pitting were conducted during the fall of 1959. The spraying in June 1961 resulted in rather poor kill. Sandberg bluegrass was the most abundant native grass. Seeded species showed poor survival. Greatest production occurred in pitted area.

7. Demer Exc. Southeast of Worland. Const. in 1959. Clipped 3 Aug. 62

Sagebrush-Grass Type. No treatment. Rain Gauge 8.

Some increase in production was noted within the exclosure but many annual weeds were present. Sagebrush was not very dense. Major grasses were Sandberg bluegrass and needleandthread. Much time will be required to fully stabilize the loose sandy soil.

8. Dutch Nick Flat Exc. West of Worland. Const. in 1955. Clipped 11 July 62.

Blue Grama Type. No Treatment. Rain Gauge 4.

Vegetation was primarily blue grama with associated grass species of Sandberg bluegrass, indian ricegrass, and needleandthread grass. The major increase in grass species has been in blue grama and Sandberg bluegrass. Changes are very slow necessitating study over a longer period of time for responses of the minor species. Perennial forbs were almost absent. Annual forbs were fewer inside as compared to outside the exclosure.

9. Farson Exc. West of Farson. Const. in 1960. Clipped 6 September 62.

Sagebrush-Grass Type. No treatment. Rain Gauge 2.

Sagebrush was very dense. Dominant grasses were western wheatgrass and needleand-thread. Soil appeared to be of glacial origin and was quite rocky.

10. Horse Creek Exc. Northeast of Shell. Const. in 1955. Clipped 2 Aug. 62.

Sagebrush-Grass Type. No treatment. Rain Gauge 12.

A uniform stand of sagebrush was present with an understory of grasses-primarily bluebunch wheatgrass and western wheatgrass. Inside the exclosure, a very definite habitat preference of these two species was developing. Western wheatgrass favored the heavier soils of the low areas, and bluebunch wheatgrass the sandier, lighter soils of the ridges. This picture was not visible outside the exclosure. A very definite improvement in range condition was present due to protection from grazing. There was some indication that grasses were outcompeting the sagebrush.

11. Kirby Creek Exc. East of Thermopolis. Const. in 1960. Clipped 21 July 62.

Greasewood Type. Seeding and Pitting Treatment. Rain Gauge 77.

Soils were very tight and very little understory vegetation was present. Seeding and pitting was conducted during the fall of 1959. Good emergence occurred during the following spring but very little permanent establishment was noted. Some native grasses were present but were very sparse.

12. Lower Gov't Draw Exc. East of Lander. Const. in 1958. Clipped 22 Aug. 62.

Sagebrush-Grass Type. Seeding, Pitting and Spraying Treatment. Rain Gauge 16.

The exclosure was located on a lowland type with fairly heavy soils. Spraying was conducted in 1958 with a good kill. Western wheatgrass, Sandberg bluegrass, and needleandthread were important and increased in abundance in spray area as compared to non-spray. Seeding and pitting studies were established during the fall of 1959. Very good emergence but little establishment was noted the following spring. Cheatgrass brome was very abundant in seeded area.

13. McGraw Flat Exc. Southeast of Lander. Const. in 1958. Clipped 23 Aug. 62.

Sagebrush-Grass Type. No treatment. Rain Gauge 14.

Big sagebrush was dense but generally less than 12" in height. This probably resulted from the climate of this higher elevation site. Grasses were sparse with bluebunch wheatgrass most abundant. Sedges were very abundant.

14. Thermopolis Relic Area. North of Thermopolis. Natural Relic. Clipped 4 Aug. 62.

Sagebrush-Grass Type. No treatment. Rain Gauge 79.

Bluebunch wheatgrass was by far the most abundant species. Big sagebrush was present, but sparse. Clumps of bluebunch wheatgrass were large, vigorous, but interspaced by large areas of bare ground. Soil was soft and mellow however.

15. Sand Gulch Exc. Northeast of Thermopolis. Const. in 1960. Clipped 1 Aug. 62.

Saltsage Type. Seeding and Pitting Treatments. Rain Gauge 72.

Saltsage had responded favorably to protection from grazing and even more so to the effect of cultivation due to seeding. This was evident in the apparent greater vigor of the plants. Native grasses present were Sandberg bluegrass and western wheatgrass.

16. Smilo Exc. Southeast of Worland. Const. in 1961. Clipped 2 Aug. 62.

Sagebrush-Grass Type. Spray Treatment. Rain Gauge 36.

Response of vegetation from protection and sagebrush control were promising, but treatment has not been effected long enough for definite results. Soils were light textured, well drained, and should be favorable for rapid response.

17. Sweetwater Exc. Southwest of Jeffrey City. Const. in 1959. Clipped 1 Aug. 62.

Sagebrush-Grass Type. No Treatment. Rain Gauge 11.

Vegetation was sagebrush with grass understory. Sagebrush was very dense, and as a consequence protection from grazing has not resulted in much change in grass composition and cover.

18. Two Mile Exc. Southwest of Tensleep. Const. in 1959. Clipped 18 July 62.

Saltsage Type. Seeding and pitting treatment. Rain Gauge 39.

Saltsage has shown little response to protection from grazing. A greater response was noted in saltsage in response to the fall of 1959 cultivation for seeding. Seedling establishment of grasses was very poor. An increase of cheatgrass brome was evident in the seeded areas.

19. Upper Gov't Draw Exc. Southeast of Hudson. Const. in 1958. Clipped 23 Aug. 62.

Sagebrush-Grass Type. Spray, seeding and pitting treatment. Rain Gauge 9.

This enclosure was located on an upland sagebrush type with bluebunch wheatgrass and Sandberg bluegrass the dominant understory species. Soils were light and apparently productive. Sagebrush control was initiated in 1958. Significant understory response has been noted. Seeding and pitting procedures were conducted in the fall of 1959. Seedling emergence was excellent but stand establishment was very poor.

20. West Pasture Exc. Northwest of Worland. Const. in 1955. Clipped 10 July 62.

Saltsage Type. No treatment. Rain Gauge 13.

Very little response in terms of vegetative cover and composition was noted due to protection from grazing, although indian ricegrass was becoming established very sparsely inside the enclosure. This trend may develop to a greater extent in years to come.

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS)

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Ant Eradication Exc. Sagebrush-Grass Type Constructed 1957 Clipped 20 Aug. 62 RG 56														
Agsm	6.5	.65	56.03	31.9	10	7.90	.79	1.21	75.84	2.25			1.44	
Pose	4.2	.42	36.21	-	3	1.32	.44	.31	12.67					
Artr	55.2	* 5.52	-	-	4	-	-	-	-					
Spco	.3	.03	2.59	-	4	.30	.07	1.00	2.88					
Saki	.1	.01	.86	-	3	6.68	2.22	66.80	64.13					
Alspp	.1	.01	.86	-	1	-	-	-	-					
Sophia	.1	.01	.86	-	1	-	-	-	-					
Blue Gilia	.2	.02	1.72	-	2	-	-	-	-					
Ledi	.1	.01	.86	-	1	-	-	-	-					
		1.16				16.20			155.52					

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	A. % Basal Area	Basal Area Comp	Av. Ht. in cm.	Absolute Precip. (base 10)	Total Wt. (grs./ sq. ft.)	A. Wt./ Plot Prec. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
Boysen Exc. Blue Grama Type Constructed 1960 Clipped 4 Aug. 62 RG 10	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Bogr.	42.0	4.20	90.71	7.2	4	18.25	4.56	.43	175.20	0.55	4.14	0.72	0.85	5.71
Sper	3.0	.30	6.47		2	3.71	1.85	1.24	35.62					
Ann. Grass	.4	.04	.86		4	.61	.15	1.52	5.86					
Ann. Forb	.9	.09	1.94		10	2.40	.24	2.67	23.04					
		4.63				24.97			239.72					

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Buffalo Creek Exc. Grass-Sagebrush Constructed 1960 Clipped 27 Jul. 62 RG 7														
Agsp	20.2	2.02	63.72	19.3	9	31.68	3.52	1.57	304.13	3.39	3.92	1.99	1.31	7.22
Pose	1.8	.18	5.68	-	9	4.43	.49	2.46	42.53					
Ann. Forb	.4	.04	1.26	-	4	7.43	1.86	18.57	71.33					
Artr	-	-	-	-	-	-	-	-	-					
Agsm	2.1	.21	6.62	18.8	3	3.23	1.08	1.53	31.01					
Phho	1.1	*.11	-	-	2	-	-	-	-					
Ann Grass	.2	.02	.63	-	2	2.05	1.02	10.25	19.68					
Eula	2.0	.20	6.30	-	1	1.21	1.21	.60	11.62					
Bogr	5.0	.50	15.77	-	1	.85	.85	.17	8.16					
		3.17				50.88			488.46					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGFTON ENCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
										J	K	L	M	N
Burnt Wagon Exc. Inside Constructed 1956 Clipped 11 Jul. 62 RG 17	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Atnu		12.43	79.31		9.5	41.41	4.36		414.1	0.73	3.90	1.31	0.60	5.81
Pere. Forbs		2.93	18.76		6.5	1.56	.24		15.6					
Ann. Forbs		0.30	1.92		6.5	3.05	.47		30.5					
		15.66				46.02			460.2					
Outside														
Atnu		10.07	60.04		10.0	21.52	2.15		215.2					
Ann. Forbs		2.30	13.72		7.5	3.49	.46		34.9					
Pere Forbs		4.40	26.24		9.5	4.00	.42		40.0					
		16.77				29.01			290.1					

-20-

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION					Growth Season Total
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15		
A	B	C	D	E	F	G	H	I	J	K	L	M	N		
Cochran Exc. Sagebrush-Grass Clipped 3 Aug. 62 RG 76															
Native															
Pose	2.7	2.70	87.66	-	8	19.85	2.48	.73	190.56	3.02	3.60	2.12	1.06	6.78	
Agsm	3.8	.38	12.34	21.6	10	10.78	1.08	2.84	103.49						
Artr	190.0	*19.00	-	-	7	-	-	-	-						
		3.08				30.63			294.05						
Sprayed															
Agsm	3.6	.36	13.28	25.5	9	8.77	.97	2.44	84.19						
Pose	23.1	2.31	85.24	-	6	19.34	3.22	.84	185.66						
Artr	33.0	*3.30	-	-	5	-	-	-	-						
Ann. Forbs	.4	.04	1.48	-	4	-	-	-	-						
		2.71				28.11			269.85						
Pitted															
Pose	17.1	1.71	87.69	-	7	19.73	2.82	1.15	189.41						
Ann. Grass	.2	.02	1.02	-	2	1.34	.67	6.70	12.86						
Ann. Forb	.8	.08	4.10	-	8	6.92	.86	8.65	66.43						
Agsm	1.4	.14	7.18	26.7	5	6.34	1.27	4.53	60.86						
Artr	5.0	*.50	-	-	1	-	-	-	-						
		1.95				34.33			329.57						
*These figures were not used in determination of basal area percentage composition.															

-21-

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGFTON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS)

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms./ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Demer Exc. Big Sagebrush Constructed 1958 Clipped 28 Jul. 62 RG 8														
Sihy	0.1	.01	.52	-	1	-	-	-	-	2.59	3.41	2.35	1.05	6.81
Pose	7.3	.73	38.22	-	6	3.59	5.98	.49	34.46					
Artr	12.6	*12.60	-	-	5	-	-	-	-					
Ann. Grass	1.6	.16	8.38	-	7	11.10	1.58	.69	106.56					
Ann. Forb	.9	.09	4.71	-	9	4.50	.50	5.00	43.20					
Bogr	9.0	.90	47.12	-	3	4.01	1.34	.44	38.50					
Oppo	55.0	*5.50	-	-	2	-	-	-	-					
Agsm	.2	.02	1.05	-	2	1.65	.82	8.25	15.84					
		1.91				24.85			238.56					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Preq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt. / plot Pres. F = E	Wt./Unit Basal Area F = A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Dutch Nick Flat Exclosure Constructed 1955 Clipped 11 Jul. 62 RG 4														
Inside														
Bogr		24.07	46.31		10.0	13.33	1.33		133.3	1.32	3.65	1.30	0.58	5.53
Pose		10.03	19.30		6.5	5.32	.82		43.2					
Ann. Forbs		15.07	29.00		10.0	39.10	3.91		391.0					
Pere Forbs		0.07	.13		.5	.08	.16		.8					
Eula		1.63	3.14		1.0	1.12	1.12		11.2					
Spc		0.03	0.06		.5	.71	1.42		7.1					
Atnu		0.40	.77		.5	1.70	3.40		17.0					
Stco		0.20	.38		-	-	-		-					
Orhy		0.47	.90		-	-	-		-					
Artr		*0.23	-		-	-	-		-					
Oppo		*5.13	-		-	-	-		-					
		51.97				61.36			61.36					
Outside														
Bogr		16.07	34.49		10	9.10	.91		91.0					
Ann. Forbs		24.56	52.71		10	38.27	3.83		382.7					
Pere Forbs		0.07	.15		1	.16	.16		1.6					
Pose		5.50	11.80		7	2.23	.32		22.3					
Eula		0.20	.43		1	.36	.36		3.6					
Spc		0.07	.15		-	-	-		-					
Oppo		*5.03	-		-	-	-		-					
Arsp		0.13	.28		-	-	-		-					
		46.60				50.12			501.2					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	Precipitation				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
Bud Kimball Sagebrush-Grass Type Constructed 1961 Clipped 20 Jul. 62 RG 42	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Native														
Agsm	2.7	.27	6.26	20.5	9	1.89	.21	.70	18.14	3.23	3.53	1.46	2.12	7.11
Artr	11.0	*1.10	-	-	2	-	-	-	-					
Pose	40.0	4.00	42.81	-	8	17.60	2.20	.44	168.96	Data taken from Little Cottonwood Res.				
Ann. Forb	.4	.04	.93	-	4	.10	.02	.25	.96					
Oppo	12.0	*1.20	-	-	1	-	-	-	-					
Phho	2.0	*.20	-	-	1	-	-	-	-					
		4.31				19.59			188.06					
Spray														
Agsm	7.3	.73	21.72	29.0	8	15.34	1.92	2.10	147.26					
Phho	1.1	*.11	-	-	2	-	-	-	-					
Pose	26.0	2.60	77.38	-	8	20.60	2.57	.79	197.76					
Oppo	85.0	*8.50	-	-	5	-	-	-	-					
Ann. Forb	0.2	.02	.60	-	2	.69	.34	3.40	6.62					
Sihy	0.1	.01	.30	16.0	1	1.02	1.02	10.20	9.79					
		3.36				37.65			361.43					

*These figures were not used in determination of basal area percentage composition.

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES, (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION					Growth Season Total
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15		
A	B	C	D	E	F	G	H	I	J	K	L	M	N		
Farson Exc. Const. 1960 Clipped 6 Sept. 62 RG 2 Sagebrush-Grass															
Agsm	.7	.07	33.33	-	7	2.11	.30	3.01	20.26	2.23		0.65	0.46		
Stco	1.3	.13	61.90	-	4	2.81	.70	2.16	26.98						
Phho	6.3	*.63	-	-	5	-	-	-	-						
Arno	127.0	*12.70	-	-	6	-	-	-	-						
Orhy	.1	.01	4.76	-	1	.28	.28	2.80	2.69						
		.84				5.20			49.93						
*These figures were not used in determination of basal area percentage composition															

-25-

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON ENCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS)

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Horse Creek Exc. Agsm Type Const. 1955 Clipped 2 Aug. 62 RG 12														
Agsm	31.0	3.10	65.40	25.6	10	66.15	6.61	2.13	635.04	3.25	4.52	2.80	0.60	7.92
Pose	16.2	1.62	34.18	-	8	9.79	1.22	.60	93.98					
Oppo	.1	*.01	-	-	1	2.49	2.49	24.90	23.90					
Artr	21.0	*2.10	-	-	2	-	-	-	-					
Ann. Forb	.2	.02	.42	-	2	-	-	-	-					
		4.74				75.74			729.02					
Agsp Type														
Agsp	28.4	2.84	95.30	15.2	9	44.45	4.94	1.56	426.72					
Pose	.1	.01	.33	-	1	-	-	-	-					
Artr	111.0	*11.10	-	-	4	-	-	-	-					
Oppo	3.1	*.31	-	-	2	-	-	-	-					
Agsm	1.3	.13	4.36	-	4	4.37	1.09	3.36	41.95					
		2.98				48.82			468.68					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Kirby Creek Exc. Greasewood Type clipped 21 Jul. 62 Constructed 1960 RG 77														
Agsm	2.3	.23	42.60	12.9	5	5.49	1.10	2.39	52.70	2.64	3.96	2.02	1.11	7.09
Pose	.2	.02	3.70	-	2	1.12	.56	5.60	10.75					
Ann Grass	1.0	.10	18.52	-	10	10.59	1.06	10.59	101.66					
Ann Forb	1.9	.19	35.18	-	10	18.31	1.83	9.64	175.78					
Oppo	20.0	*2.00	-	-	1	-	-	-	-					
Save	20.0	*2.00	-	-	1	-	-	-	-					
		.54				35.51			340.89					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS)

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Lower Gov't Draw Sagebrush-Grass Clipped 22 Aug. 62 Constructed 1958 RG 16														
Spray-Inside														
Agsm	37.0	3.70	60.55	28.5	10	38.65	3.86	1.04	371.04	2.46			2.14	
Pose	24.0	2.40	39.28	-	7	14.49	2.07	.60	139.10					
Ann Forb	.1	.01	.16	-	1	-	-	-	-					
Pitted-Spray		6.11				53.41			511.88					
Agsm	1.9	.19	4.22	-	10	14.03	1.40	7.38	134.69					
Pose	36.2	3.62	80.44	-	8	33.39	4.17	.92	320.54					
Ann Grass	3.8	.38	8.44	-	10	13.91	1.39	3.66	133.54					
Stco	3.0	.30	6.67	-	1	8.08	8.08	2.69	77.57					
Spco	.1	.01	.22	-	1	-	-	-	-					
Pitted-No spray		4.50				69.41			666.34					
Pose	16.0	1.60	59.70	-	5	-	-	-	-					
Agsm	7.3	.73	27.24	-	6	-	-	-	-					
Ann Forb	.2	.02	.75	-	2	-	-	-	-					
Artr	90.0	*9.00	-	14.1	3	-	-	-	-					
Ann Grass	3.3	.33	12.31	-	6	-	-	-	-					
Row-Unsprayed		2.68												
Agsm	24.3	2.43	69.83	25.7	10	36.51	3.65	1.50	350.50					
Pose	10.0	1.00	28.73	-	3	11.30	3.76	1.13	108.48					
Artr	127.0	*12.70	-	14.4	6	-	-	-	-					
Sophia	.1	.01	.29	-	1	-	-	-	-					
Oppo	12.0	*1.20	-	-	1	-	-	-	-					
Ann. Forb	.3	.03	.86	-	3	-	-	-	-					
Stco	.1	.01	.29	-	1	.78	.78	7.8	7.49					
		3.48				48.59			466.47					

*These areas were not used in determination of basal area percentage composition.

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative Cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
										J	K	L	M	N
Lower Gov't Draw Row-spray	A	B	C	D	E	F	G	H	I					
Stco	8.0	.80	25.56	-	3	12.62	4.21	1.58	121.15					
Pose	12.2	1.22	38.98	-	5	10.45	2.09	.86	100.32					
Agsm	2.8	.28	8.94	25.8	9	15.83	1.76	5.65	151.97					
Ann Grass	8.2	.82	26.20	-	7	29.13	4.16	3.56	279.65					
Artr	25.0	*2.50	-	-	1	-	-	-	-					
As-spp.	.1	.01	0.32	-	1	1.19	1.19	11.90	11.42					
		3.13				69.22			664.51					
Outside-No spray														
Agsm	1.0	.10	30.30	22.7	10	4.90	.49	4.90	47.04					
Pose	1.6	.16	48.48	-	7	1.73	.23	1.08	16.61					
Stco	.1	.01	3.03	-	1	.40	.40	4.00	3.84					
Artr	52.0	*5.20	-	13.5	4	-	-	-	-					
Ann Grass	.3	.03	9.09	-	3	-	-	-	-					
Ann Forb	.2	.02	6.06	-	2	.09	.04	.45	.86					
Spco	11.0	.01	3.03	-	1	-	-	-	-					
		.33				7.12			68.35					
Outside spray														
Agsm	1.9	.19	25.69	25.4	10	2.95	.29	1.55	28.32					
Pose	4.7	.47	63.50	-	10	6.60	.66	1.40	63.36					
Kocr	.1	.01	1.35	-	1	.14	.14	1.40	1.34					
Ann Grass	.7	.07	9.46	-	7	4.79	.68	6.84	45.98					
Oppo	.1	*.01	-	-	1	-	-	-	-					
		.74				14.48			139.00					
Inside-No spray														
Agsm	5.5	.55	23.60	20.5	9	28.58	3.17	5.20	274.37					
Pose	17.3	1.73	74.25	-	7	12.44	1.78	.72	119.42					
Artr	184.1	*18.41	-	10.5	7	-	-	-	-					
Ann Grass	.1	.01	.43	-	1	-	-	-	-					
Ann Forb	.3	.03	1.29	-	3	-	-	-	-					
Spco	.1	.01	.43	-	1	-	-	-	-					
		2.33				41.02			393.79					
*These figures were not used in determination of basal area percentage composition.														

-29-

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt. / Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
McGraw Flat Exc. Sagebrush-Grass Clipped 23 Aug. 62 Constructed 1958 RG 14														
Agsm	1.9	.19	10.27	16.4	10	8.69	.87	4.57	83.42	2.02				
Cafi	12.2	1.22	65.95	-	6	2.73	.45	.22	26.21					
Artr	196.0	*19.60	-	6.4	8	-	-	-	-					
Pose	4.2	.42	22.70	-	3	.95	.32	.23	9.12					
SpcO	.1	.01	.54	-	1	-	-	-	-					
Ann. Forb	.1	.01	.54	-	1	-	-	-	-					
Phho	.1	*.01	-	-	1	-	-	-	-					
		1.85				12.37			118.75					

*These figures were not used in determination of basal area percentage composition.

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON ENCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
A	B	C	D	E	F	G	H	I	J	K	L	M	N	
North Butte-Thermopolis														
Sagebrush-Grass														
Clipped 4 Aug. 62														
Relict Area														
RG 79														
Agsp	26.5	2.65	67.43	21.7	10	105.93	10.59	3.99	1016.93	4.07	3.74	2.05	2.07	7.86
Cafi	12.2	1.22	31.04	---	8	4.23	.53	.35	40.61					
Artr	110.0	*11.00	-	---	4	2.90	.72	.03	27.84					
Spco	.2	.02	.51	---	3	.03	.01	.15	.30					
Pose	.3	.03	.76	---	3	3.27	1.09	10.90	31.39					
Phho	.1	*.01	-	---	1	-	-	-	-					
Ann. Forb	.1	.01	.25	---	1	.40	.40	4.00	3.84					
		3.93				116.76			1120.91					

*These figures were not used in determination of basal area percentage composition.

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F - E	Wt./Unit Basal Area F - A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Sand Gulch Exc. Composite Constructed 1960 Clipped 19 Jul. 62 Native														
Atnu	95.34	9.53	92.35	-	6.8	37.27	5.48	.39	357.79	2.19	4.13	1.85	.89	6.87
Orhy	.60	.06	.58	-	1.5	1.10	.73	1.83	10.56					
Agsm	.70	.07	.68	-	2.5	1.21	.48	1.73	11.62					
Ann Grass	.42	.04	.39	-	4.2	10.44	2.48	24.85	100.22					
Pose	3.10	.31	3.00	-	3.0	3.56	1.19	1.15	34.18					
Sihy	3.10	.31	3.00	-	2.0	3.45	1.72	1.11	33.12					
		10.32				57.03			547.49					
Cultivated														
Atnu	123.66	12.37	92.24	7.57	6.4	33.26	5.19	.27	319.30					
Agsm	2.97	.29	2.16	13.10	4.6	5.09	1.11	1.71	48.86					
Pose	4.67	.47	3.50	-	4.2	3.53	.84	.75	33.89					
Oppo	115.00	11.50	46.17	-	5.0	-	-	-	-					
Bogr	2.20	.22	1.64	3.7	4.0	2.64	.66	1.20	25.34					
Ann. Forb	.55	.05	.37	-	1.0	.31	.31	.56	2.98					
Ann. Grass	.10	.01	.07	-	1.0	.13	.13	1.30	1.25					
		13.41				44.96			431.62					

- 32 -

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS)

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Smilo Exc. Sagebrush-Grass Constructed 1962 Clipped 2 Aug. 62 RG 36 Native														
Agsp	2.3	.23	6.91	15.0	4	2.68	.67	1.16	25.73	3.28	3.62	1.91	1.43	6.96
Pose	19.2	1.92	57.66	-	6	14.71	2.45	.77	141.22					
Sihy	3.0	.30	9.01	-	1	-	-	-	-					
Feoc	2.5	.25	7.51	-	7	-	-	-	-					
Artr	51.1	*5.11	-	-	3	-	-	-	-					
Ann. Brome	1.5	.15	4.50	-	6	13.76	2.29	9.17	132.10					
Ann. Forb	1.6	.16	4.80	-	7	6.13	.87	3.83	58.85					
Agsm	3.2	.32	9.61	17.9	5	9.21	1.84	2.88	88.42					
Oppo	5.0	*.50	-	-	1	-	-	-	-					
		3.33				46.49			446.32					
Sprayed														
Pose	27.2	2.72	88.03	-	7	20.78	2.97	.76	199.49					
Agsm	1.4	.14	4.53	18.1	5	2.50	.50	1.78	24.00					
Feoc	.4	.04	1.29	-	4	-	-	-	-					
Bogr	.2	.02	.65	-	2	.56	.28	2.80	5.38					
Stco	.1	.01	.32	27.7	1	.77	7.70	7.70	7.39					
Sihy	.3	.03	.97	-	3	1.48	.49	4.90	14.21					
Ann. Grass	1.3	.13	4.21	-	4	4.86	1.21	3.73	46.66					
		3.09				30.95			297.12					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOCETON ENCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
Sweetwater Exc. Constructed 1959 Clipped 1 Aug. 62 RG 11	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Stco	48.1	4.81	75.87	13.6	9	29.80	3.31	.62	286.08					
Cafi	2.4	.24	3.78	"	6	.84	.14	.35	8.06					
Kocr	6.2	.62	9.78	"	6	2.07	.34	.33	19.87					
Agsm	.1	.01	.16	"	1	.03	.03	.33	.29					
Ox spp.	.2	.02	.31	"	2	"	"	"	"					
Pose	.2	.02	.31	"	2	.38	.19	1.90	3.65					
Artr	.3	*.03	"	"	3	"	"	"	"					
Gusa	6.2	.62	9.78	"	3	"	"	"	"					
Phho	.1	*.01	"	"	1	"	"	"	"					
Oppo	25.0	*2.50	"	"	1	"	"	"	"					
		6.34				33.12			317.95					

*These figures were not used in determination of basal area percentage composition.

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON ENCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS)

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Two Mile Hill Exc. Saltsage Type Constructed 1960 Clipped 18 Jul. 62 RG 39														
Native														
Atnu	60.55	6.05	83.92	5.80	6.4	32.71	5.11	.54	314.02	3.88	3.52	2.46	2.00	7.98
Pose	4.16	.42	5.82	-	3.9	3.46	.89	.83	33.22					
Ann. Forb	6.00	.60	8.32	-	8.2	4.84	.59	.80	46.46					
Ann. Grass	1.45	.14	1.94	-	6.0	.98	.16	.67	9.40					
Seeded		7.21				41.99			403.10					
Atnu	32.48	3.25	67.56	-	4.4	20.30	4.61	.62	194.88					
Pose	8.70	.87	18.09	-	2.0	4.63	2.31	.53	44.45					
Brte	1.00	.10	2.08	-	10.0	9.44	.94	9.44	90.62					
Ann. Forb	.86	.09	1.87	-	8.8	3.23	.37	3.75	31.01					
Ann. Grass	1.96	.20	4.16	-	7.3	14.67	2.01	7.48	140.83					
Sihy	2.00	.20	4.16	-	1.0	3.10	3.10	2.55	29.76					
Orhy	1.00	.10	2.00	-	1.0	4.70	4.70	4.70	45.12					
Pitted		4.81				60.07			576.67					
Atnu	74.44	7.44	88.48	5.90	6.3	33.10	5.25	.44	317.76	3.88	3.52	2.46	2.00	7.98
Pose	5.18	.52	6.18	-	2.7	4.33	1.60	.83	41.57					
Brtr	1.17	.12	1.42	-	7.5	4.16	.55	3.55	39.94					
Ann. Forb	.90	.09	1.07	-	5.4	2.48	.46	2.75	23.81					
Ann Grass	2.42	.24	2.85	-	8.7	9.66	1.11	3.99	92.74					
		8.41				53.73			515.82					

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
										J	K	L	M	N
Upper Gov't Draw Sagebrush-Grass Constructed 1958 Clipped 21 Aug. 62 RG 9	A	B	C	D	F	F	G	H	I	J	K	L	M	N
Outside-No spray														
Agsm	2.8	.28	7.33	-	10	7.50	.75	2.68	72.00	1.45			1.45	
Pose	33.2	3.32	86.91		10	6.60	.66	.20	63.36					
Artr	55.0	*5.50	-	10.2	2	-	-	-	-					
Phho	1.0	*.10	-	-	1	-	-	-	-					
Plpu	1.2	.12	3.14		3	-	-	-	-					
Kocr	1.0	.10	2.62		1	1.08	1.08	1.08	10.37					
		3.82				15.18			145.73					
Outside-Spray														
Agsm	2.8	.28	10.29	-	10	13.19	1.32	4.71	126.62					
Pose	24.4	2.44	89.71	-	10	9.35	.93	.38	89.76					
Artr	15.0	*1.50	-	11.5	1	-	-	-	-					
		2.72				22.54			216.38					
Inside-No spray														
Agsm	7.6	.76	18.18	20.8	10	9.15	.91	1.20	87.84					
Pose	31.2	3.12	74.64	-	10	8.87	.89	.28	85.15					
Kocr	3.0	.30	7.18	-	2	.80	.40	.27	7.68					
Artr	13.9	*13.90	-	12.0	6	-	-	-	-					
		4.18				18.82			180.67					
Inside-Spray														
Agsm	13.3	1.33	43.46	24.2	10	17.04	1.70	1.28	163.58					
Kocr	2.0	.20	6.54	-	1	.61	.61	.30	5.86					
Pose	15.3	1.53	50.00	-	8	8.36	1.04	.55	80.26					
		3.06				26.01			249.70					
*These figures were not used in determination of basal area percentage composition.														

-36-

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

EXCLOSURE AND VEGETATIVE COVER	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
Upper Gov't Draw Between Rows-No spray	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Agsm	7.0	.70	23.25	20.7	8	18.93	2.37	2.70	181.73					
Pose	18.0	1.80	59.80	-	6	6.02	1.00	.33	57.79					
Kocr	5.1	.51	16.94	-	4	5.76	1.44	1.13	55.30					
Artr	242.0	*24.20	-	12.3	6	-	-	-	-					
Phho	.2	*.02	-	-	2	-	-	-	-					
		3.01				30.71			294.82					
Between Rows-Spray														
Agsm	24.3	2.43	45.68	21.7	8	63.27	7.91	2.60	607.39					
Pose	23.2	2.32	43.61	-	8	17.81	2.23	.77	170.98					
Kocr	4.2	.42	7.89	-	4	4.30	1.07	1.02	41.28					
Stco	1.1	.11	2.07	-	2	7.41	3.70	6.73	71.14					
Oppo	2.0	*.20	-	-	1	-	-	-	-					
		5.32				92.79			890.79					
Pitted-No spray														
Agsm	18.4	1.84	68.15	23.7	10	41.32	4.13	2.24	396.67					
Pose	8.2	.82	30.37	-	4	28.80	7.20	3.51	276.48					
Artr	35.0	*3.50	-	18.7	2	-	-	-	-					
Oppo	10.0	*1.00	-	-	1	-	-	-	-					
Gilia	.1	.01	.37	-	1	.15	.15	1.5	1.44					
Phho	.1	*.01	-	-	1	-	-	-	-					
SpcO	.3	.03	1.11	-	3	-	-	-	-					
Ann Grass	-	-	-	-	-	5.58	-	-	53.57					
		2.70				75.85			728.16					
Pitted-spray														
Agsm	23.0	2.30	71.65	23.6	10	32.60	3.26	1.42	312.96					
Pose	9.0	.90	28.03	-	3	1.28	.42	.14	12.29					
Plpu	.1	.01	.31	-	1	.45	.45	4.50	4.32					
		3.21				34.33			329.57					
*These figures were not used in determination of basal area percentage composition.														

HERBAGE AND PRECIPITATION DATA FROM WYOMING HALOGETON EXCLOSURE STUDIES (WEIGHTS ON OVEN DRY BASIS).

Exclosure and Vegetative cover	Total % Basal Area	Av. % Basal Area	Basal Area Comp.	Av. Ht. in cm.	Absolute Freq. (Base 10)	Total Wt. Gms/ 10 sq. ft.	Av. Wt./ Plot Pres. F ÷ E	Wt./Unit Basal Area F ÷ A	Pounds per acre F x 9.6	PRECIPITATION				
										Oct. 15 to April 15	April 15 to July 1	July 1 to Sept. 1	Sept. 1 to Oct. 15	Growth Season Total
A	B	C	D	E	F	G	H	I	J	K	L	M	N	
West Pasture Exc. Constructed 1955 Clipped 10 Jul. 62 RG 13 Inside														
Atnu	14.20	50.18		10	33.31	3.33		333.1	0.70	3.77	1.77	0.55	6.09	
Ann. Forb	5.73	20.24		10	18.02	1.80		180.2						
Pose	1.90	6.71		3	.86	.29		8.6						
Orhy	1.47	5.18		.5	.11	.02		1.1						
Per Forb	1.37	4.82		3	5.75	1.91		57.5						
Arsp	0.77	2.71		1.5	6.25	4.10		62.5						
Arpe	0.03	0.12		1.0	6.95	6.95		69.5						
Spco	-	-		.5	.55	.11		5.5						
Oppo	2.87	10.12		-	-	-		-						
	28.34					71.80		718.0						
Outside														
Atnu	9.13	34.82		10	18.79	1.88		187.9						
Ann. Forb	8.53	32.53		10	27.94	2.79		279.4						
Pose	2.23	8.51		5	2.56	.26		25.6						
Orhy	0.07	0.25		.5	.06	.01		.6						
Per Forb	1.40	5.34		2	.92	.46		9.2						
Arsp	1.00	3.81		3.5	1.12	.30		11.2						
Oppo	3.87	-		-	-	-		-						
	26.23							513.9						

SELECTION AND IMPROVEMENT OF EUROTIA LANATA (WINTER-FAT)

by
W. A. Riedl
Loren Nelson
W. W. Ellis
Morton May 1/

Readings for plant height and number of tillers were made on plants which were selected for high and low seedling vigor and transplanted to the field in the spring of 1959. There was a high positive correlation between seedling vigor and height and number tillers. Selections were made of vigorous male and female plants to be placed in a crossing block the following year to develop superior strains.

Readings were also made on the survival of plants from the 1961 seeding made with the range-seeder. The survival was better for the April 4 planting than on the May 16 planting. Shallow plantings were better on plowed ground but deep plantings were better on sod.

Additional seed collections were made in the Powell, Shell and Worland areas.

The finding that plants selected for high seedling vigor also had a higher subsequent growth indicates that selection can be made for higher yielding lines early in the breeding program. The fact that early spring shallow plantings on plowed ground and deep plantings on sod produced the best stands and had the highest survival will aid in establishing this on the range. The work on establishment will be expanded to include date of planting and various treatments at several locations.

1/ Professor of Plant Breeding, Division of Plant Science
Graduate Assistant, Crops, Division of Plant Science
Associate Professor of Agricultural Biochemistry, Division of Biochemistry
Associate Professor of Range Management, Division of Plant Science, respectively,
University of Wyoming, Laramie, Wyoming.

EUROTIA LANATA SEEDING TRIALS

by
Morton May 1/

Relatively few plant species are adapted to saline and alkaline soils. Of the plants that will endure these soil conditions (collectively known as halophytes) it would be difficult to name a browse plant of higher palatability or greater forage value than winter fat (Eurotia lanata). Its high palatability to all classes of livestock as well as many wildlife species has subjected the plant to heavy use, resulting in a depletion of the species in many localities. Other areas, presently producing little forage, appear to have conditions that would be favorable to support good stands of winter fat.

As winter fat reproduction is entirely dependent upon seed, studies are being conducted to develop lines differing in seedling development. At the present time greenhouse studies are in progress to determine the following: (1) proper depth of planting of various strains or varieties, (2) rate of emergence, germination and seedling vigor as related to planting depth, (3) rate of emergence, germination and seedling vigor as related to strains of winter fat collected at different locations, (4) rate of emergence, germination and seedling vigor of winter fat where the seed was collected at the same location but at different times of the year, and (5) the effect of seed storage time on germination, rate of emergence and seedling vigor.

The best selection of winter fat, based on germination and forage production determined earlier trials, will be used in field plantings in the spring of 1963. The basic objective of the field seeding trials will be to determine proper planting time. Seedings will be made at one or two week intervals (depending on soil and climatic conditions) throughout the spring and early summer months at a planting depth derived from the greenhouse studies. These seeding trials will later be compared to fall seedings.

Associate Professor in Range Management, Division of Plant Science, University of Wyoming,
Laramie, Wyoming.

EFFECT OF BIG SAGEBRUSH CONTROL UPON THE COVER
AND PRODUCTION OF NATIVE FORAGE SPECIES,
SOIL MOISTURE CONTENT, AND SNOW COVER AND
MOISTURE CONTENT

by
Earl W. Chamberlain 1/

A description of the experimental area, methods of sampling vegetation, snow cover, and soil moisture, and the yearly survey data are included in the Bureau of Land Management Annual Reports of 1958 through 1961. This report, 1962, is concerned mainly with the 1962 survey data but includes tabulated data covering five years of this project. Also included in this report is the monthly snow depth and moisture content of the snow for the five-year period. In addition tabulated figures showing amount of moisture per foot of soil are included for the year 1962.

Vegetative Composition

The vegetative composition of the sprayed rangeland as effected by chemical control of big sagebrush, over a five-year period, is presented in Table I.

The foliage cover of the native grasses increased 2.6 per cent over the 1961 figures, however, it appears that this is probably the maximum increase that will be obtained. Thickspike wheatgrass (Agropyron dasystachyum) makes up more than half of the grass cover.

The foliage cover of sagebrush remained nearly the same as the 1961 survey and the sprayed area is almost identical to the 1961 figures.

Production and Utilization

As shown in Table II, the production for 1962 dropped somewhat, which further verifies the statement in the 1961 report that maximum production probably was reached three years after spraying. However, moisture conditions will make the production figures change from year to year. Utilization figures are not available due to very light grazing of the study area.

Snow Cover and Moisture Content

Figures on snow depth and moisture content of the snow are shown in Table III. The five-year average shows a slight advantage of snow depth and moisture content in the sprayed area but the difference is not significant.

Soil Moisture Studies

In the summer of 1962 a new method of measuring soil moisture was initiated. These studies were conducted by the use of a neutron scattering probe. Moisture tubes were installed in the Red Desert on June 18, 1962. There were three tubes located in the sprayed area and three in the unsprayed area. Three readings were taken in July, September, and November during 1962. The figures in Table IV show the amount of moisture present in each foot of soil on each of the reading dates.

TABLE I. FOLIAGE COVER OF BIG SAGEBRUSH/GRASS TYPE RANGELAND IN THE DIVIDE GRAZING DISTRICT OF SOUTHERN WYOMING, ONE, TWO, THREE, FOUR AND FIVE YEARS AFTER CHEMICAL SAGEBRUSH CONTROL

Species	^{1/} 1957	1958	1959	1960	1961	1962
<u>Shrubs</u>						
Big sagebrush (<u>Artemisia tridentata</u>)	25.4	16.5	11.6	17.7	12.7	11.6
<u>Semi-shrubs</u>						
Slender eriogonum (<u>Eriogonum microthecum</u>)	0.6	0.5	1.0	1.0	0.1	0.1
Low Douglas rabbitbrush (<u>Chrysothamnus viscidiflorus pumilus</u>)	<u>2.4</u>	<u>1.5</u>	<u>3.3</u>	<u>7.0</u>	<u>1.5</u>	<u>1.5</u>
Total.....	<u>3.0</u>	<u>2.0</u>	<u>4.3</u>	<u>8.0</u>	<u>1.6</u>	<u>1.6</u>
<u>Forbs</u>						
Smooth Hoods Phlox (<u>Phlox glabrata</u>)	2.9	1.0	1.0	2.5	0.5	0.6
Stemless goldenweed (<u>Haplopappus acaulis</u>)	0.6	0.1	---	0.3	0.5	0.1
Prickly pear (<u>Opuntia polyacantha</u>)	0.3	0.1	0.3	0.9	0.4	0.1
Other species	<u>0.5</u>	<u>0.7</u>	<u>0.6</u>	<u>0.4</u>	<u>0.8</u>	<u>0.4</u>
Total.....	<u>4.3</u>	<u>1.9</u>	<u>1.9</u>	<u>4.1</u>	<u>2.2</u>	<u>1.2</u>
<u>Grasses</u>						
Thickspike wheatgrass (<u>Agropyron dasystachyum</u>)	5.4	12.5	23.8	23.2	22.1	31.1
Prairie junegrass (<u>Koeleria cristata</u>)	1.2	13.4	9.6	9.2	9.4	0.2
Needlegrass (<u>Stipa comata</u> and <u>lettermani</u>)	1.5	1.5	1.9	1.3	3.0	3.1
Indian ricegrass (<u>Oryzopsis hymenoides</u>)	0.8	1.1	0.9	4.6	4.1	1.0
Sandberg bluegrass (<u>Poa secunda</u>)	4.0	1.7	2.3	2.7	5.4	13.6
Bottlebrush squirreltail (<u>Sitanion hystrix</u>)	<u>1.2</u>	<u>3.0</u>	<u>4.2</u>	<u>6.8</u>	<u>5.4</u>	<u>3.0</u>
Total.....	<u>14.1</u>	<u>33.2</u>	<u>42.7</u>	<u>47.8</u>	<u>49.4</u>	<u>52.0</u>
<u>Bare area</u>	53.2	46.4	39.5	22.2	33.9	33.6

^{1/} Original survey, made before chemical applications.

TABLE II. AIR-DRY FORAGE PRODUCTION ON SPRAYED AND UNSPRAYED AREAS ON THE RED DESERT. ^{1/}

Year	Pounds Air-dry Forage per Acre sprayed	unsprayed
1959	190	98
1960	632	118
1961	542	48
1962	<u>375</u>	<u>167</u>
-year Average:	435	108

^{1/} Plots sprayed in 1957; no forage production obtained in 1958.

TABLE III. SNOW COVER AND MOISTURE CONTENT

Red Desert - 1958-1962

	Snow Depth	<u>Sprayed</u>	Snow Depth	<u>Unsprayed</u>
		H ₂ O Content		H ₂ O Content
1958 - November	3.3"	0.8"	3.1"	0.8"
1959 - January	5.3"	1.4"	5.1"	1.3"
1960 - February	10.8"	2.6"	11.4"	2.6"
March	11.0"	3.7"	11.6"	3.6"
Average	11.4"	3.2"	11.5"	3.1"
1961 - February	3.1"	0.4"	2.8"	0.4"
March	4.0"	0.7"	3.6"	0.7"
Average	3.6"	0.6"	3.2"	0.6"
1962 - January	9.6"	2.8"	7.4"	1.8"
March	6.6"	1.9"	6.2"	1.7"
Average	8.1"	2.4"	6.8"	1.8"
5 - year Average	6.3"	1.7"	5.9"	1.5"
Sprayed in 1957.				

TABLE IV. INCHES OF MOISTURE PER FOOT AT EACH SOIL DEPTH IN JULY, SEPTEMBER, AND NOVEMBER, 1962 AS DETERMINED BY THE NEUTRON SCATTERING PROBE ON THE RED DESERT.*

Soil Depth in inches	July 12, 1962		September 5, 1962		November 10, 1962	
	Sprayed	Unsprayed	Sprayed	Unsprayed	Sprayed	Unsprayed
4½			1.14	1.31	1.44	1.57
6	1.11	1.36	1.04	1.33	1.42	1.59
12	1.28	1.78	1.22	1.65	1.29	1.68
18	1.42	1.89	1.35	1.75	1.38	1.81
24	1.53	1.89	1.45	1.75	1.44	1.72
30	1.61	1.85	1.47	1.67	1.43	1.69
36	1.63	1.68	1.45	1.49	1.46	1.51
42	1.45	1.60	1.33	1.50	1.31	1.45
48	1.37	1.45	1.24	1.33	1.23	1.31
54	1.33	1.24	1.22	1.24	1.19	1.24
60	1.26	1.26	1.20	1.30	1.20	1.26

*Figures shown are an average of three tubes.

BLM LIBRARY
RS 150A BLDG. 50
DENVER FEDERAL CENTER
P.O. BOX 25047
DENVER, CO 80225